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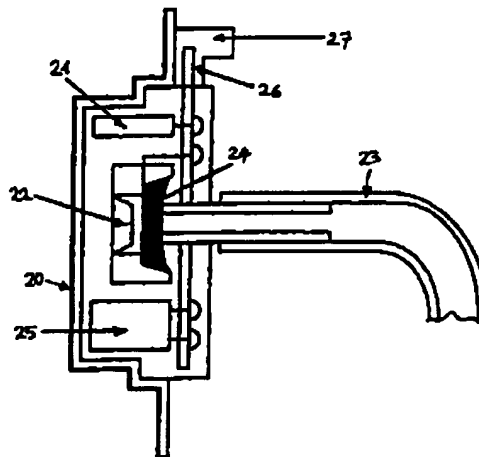
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(54) **Washing machine provided with regulation and control means**

(57) In a washing machine there are enclosed in a single water-tight casing (20), which is arranged below the minimum level (L) that can be reached by the liquor during the operating cycles of the machine: the sensor (21) of the temperature regulation and control means, the sensor (22) of the regulation and control means for the level of the washing liquor inside the washing tub or vessel (5), wherein said sensors are preferably integrated into a single microchip.

In the case of a clothes washing or similar machine, in the casing there is also enclosed at least a sensor (25) that is adapted to detect the oscillations of the washing or suspended assembly (4) of the machine, and is preferably associated to means adapted to adjust the trim of the same suspended assembly (4) so as to eliminate possible dynamic imbalance states thereof.

**FIG. 2**



**EP 1 087 052 A2**

## Description

[0001] The present invention refers to a washing machine, such as a clothes washing or combined clothes washing and drying machine, or even a dish-washing machine, particularly although not solely adapted for use in household, i.e. residential applications.

[0002] Washing machines of the above cited kind are generally known to comprise a structural outer casing having a substantially parallelepiped shape, and an inner washing tub or vessel adapted to contain the washload items during the operating cycles of the machine.

[0003] In the case of clothes washing or combined clothes washing and drying machines, the washing tub, which encloses a drum rotating for instance about a more or less horizontal axis, is a part of a washing assembly that is elastically suspended inside said outer casing by means of sprung and preferably also vibration-damping means. A tubing made of an elastic material, and generally in a bellows-like configuration, departs from the lowest point of the washing tub and connects to the suction side of a pump provided to let off and/or recirculate the washing and rinsing liquor.

[0004] In order to be able to carry out the various phases included in the operating cycles thereof, the washing machine also comprises, further to the already mentioned pumping means, various functional component parts that are electrically interconnected, such as driving means for the rotating drum, programming and sequencing means for the operating cycles that can be selected by the user, electromagnetic valves to let the washing and rinsing liquor into the tub or vessel, heating elements (usually of the electric resistance type), regulation and control means of the temperature and the level of the washing liquor and, in the more sophisticated washing machine models, also means for controlling and possibly even adjusting the dynamic trim of the washing or suspended assembly in order to compensate for possible imbalance states that may be brought about by an unbalanced distribution of the washload.

[0005] In a traditional washing machine, therefore, the necessary wiring is rather complex, the more so considering that the above mentioned regulation and control means are physically situated in positions that may be even quite distant from each other. The wiring may therefore be rather easily exposed to assembly errors and certainly not such as to ensure a maximum extent of reliability, further to contributing to a certainly not negligible extent to the overall manufacturing costs of the washing machine, which thing, as it is true in connection with all products intended for the consumer market, is a factor of paramount industrial importance.

[0006] It therefore is a main purpose of the present invention to provide a washing machine in which, while ensuring the same functionality as a traditional machine, the wiring is actually simplified.

[0007] According to the present invention, this and further aims are reached in a washing machine having the characteristics as recited in the appended claims, as this can be readily inferred from the description that is given below by way of non-limiting example of a preferred, although not sole embodiment with reference to the accompanying drawing, in which:

- Figure 1 is a schematical, partially cut-away front view of a residential-type washing machine;
- Figure 2 is a longitudinal-section view of the casing enclosing the sensors of the regulation and control means of the washing machine of Figure 1, said sensors being shown in a simplified manner.

[0008] In a most traditional manner, the washing machine illustrated in Figure 1 comprises a structural outer casing 1 in the shape of substantially a parallelepiped, to which there is suspended by means of spring means 2 and friction-type vibration-dampers 3 a washing or suspended assembly 4, which in turn comprises a washing tub 5 and a drum 6 that is enclosed in the same tub and is adapted to rotate about a more or less horizontal axis X. For reasons of greater simplicity such items as the opening for loading the clothes into the washing assembly, which can be arranged either frontally or on the top according to the washing machine models, and the related doors or lids, are not shown in the Figure.

[0009] As generally well-known in the art, a washing machine also comprises a number of throughout per se known functional component parts, which are only illustrated either partially or in a simplified manner in the accompanying Figure 1. Among these component parts, the ones that more closely relate to or are of relevance in connection with the present invention are the motor 7 used to drive the drum 6; an electromagnetic valve group 8 used to fill water from the supply mains into the washing tub 5 through a piping system 9 in view of washing and rinsing the clothes; pumping means 10, whose suction or return side is connected via a bellows-like flexible connecting tube 12 to the lowest point of the tub 5; and a programme sequence control unit 13 for the selection of the desired operating cycles by the user. For reasons of greater simplicity, the per se well-known electric heating element used to heat up the washing liquor is not shown here.

[0010] According to a main feature of the present invention, the sensors associated to the regulation and control means of the washing machine, which will be described in a more detailed manner below, are brought together and, actually, arranged and enclosed in a single sealed, i.e. water-tight casing 20, which is situated on the inner surface of the tub 5 in a position below the level that is generally indicated at L in Figure 1. This is the minimum or lowest level that can be reached by the washing or rinsing liquor inside the tub 5 during the

operating cycles of the machine. Schematically illustrated with chain lines, and generally indicated at 30, in the same Figure 1 are also the electric interconnections between the various functional component parts, among which the selective activation of the above cited sensors in accordance with the individual phases of the operating cycles performed by the machine.

[0011] Figure 2 illustrates in a more detailed manner the arrangement inside the casing 20, which is in the shape of a capsule, is preferably made of a metal (eg. stainless steel) capable of withstanding both the corrosive action of the detergents and the clothes washing temperatures, and is surrounded by an appropriate water-tight sealing ring (not shown). Generally indicated at 21 there is a thermistor-based sensor; at 22 a sensor, eg. of the piezoresistive type, which, via a small tube 23 and under the interposition of a small insulating disk 24, is connected to the bellows-like flexible connecting tube 12 (as this is shown in Figure 1); at 25 an accelerometric sensor; at 26 the board of a printed circuit on to which the above cited sensors are materially deposited; and at 27 the multi-pole terminal of the corresponding electric interconnection lines 30.

[0012] According to a further feature of the present invention, the thermistor-based sensor 21 performs a twofold task, ie., further to the regulation and control of the temperature of the liquor inside the washing assembly 4 (by acting on the afore mentioned heating element), it in fact also ensures the thermal compensation of the other sensors enclosed within the same casing 20, as necessary in those phases of the operating cycles of the machine in which the liquor is hot, in accordance with the commands transmitted via the interconnecting lines 30 by the programme sequence control unit 13. In this way, unacceptable measurement errors are effectively avoided, which may be brought about by differences between the actual operating temperature and the rated temperature of the sensors 22 and 25.

[0013] The sensor 22, in turn, performs the regulation and the control of the level of the liquor within the washing assembly 4 (by acting of the electromagnetic valve group 8 rather than on the pumping means 10, depending on the individual phases of the operating cycles performed by the machine, in accordance with the commands received from the programme sequence control unit 13).

[0014] Finally, the accelerometric sensor 25 ensures the detection of the oscillations of the washing assembly 4, in particular during the transition periods from the low-speed phases of the operating cycles of the machine to the high-speed ones. In a preferred manner, on the same printed-circuit board 26 there are provided feed-back means that are adapted to modify the dynamic trim of the same suspended assembly so as to eliminate the possibly detected dynamic imbalance states thereof, according to methods that are per se well-known to those skilled in the art.

[0015] The advantages offered by the present invention can be summarized as follows:

- the wiring harness needed to electrically interconnect the various functional component parts of the washing machine is greatly simplified;
- the array of sensors 21, 22 and 25, with the therewith associated printed-circuit board 26, can form a subassembly capable of being manufactured and tested separately before being assembled on to the inner surface of the tub 5 of the washing machine;
- said assembly can furthermore be carried out in a particularly simple and low-cost manner;
- the reliability of the washing machine is improved, thanks also to a reduced possibility for water leakages from the washing tub to occur where the sensors would have to be inserted.

[0016] In a variant of the present invention, all three above-cited sensors 21, 22 and 25 are integrated into a single solid-state component part (microchip), in a manner that obviously boosts to a considerable extent the already significant advantages mentioned above.

[0017] It will of course be appreciated that the present invention may be developed by those skilled in the art into embodiments that may differ from the afore illustrated one, and that it may also be implemented in some simplified versions. For instance, the accelerometric sensor will certainly be omitted in the case that the machine is a dishwasher, and may even be omitted if the machine is a clothes washer spinning at a very low rotating speed of the drum (ie. up to max. 500 to 600 rpm). The casing containing the sensors may also be mounted directly on the connecting tube 12 provided between the tub 5 and the pumping means 10, thereby doing away with the small tube 23.

## Claims

1. Washing machine comprising among other things:
  - an outer casing (1)
  - an inner tub or vessel (5) adapted to contain the washload items during the operating cycles of the machine,
  - as structural component parts, and at least
    - electromagnetic valve means (8) for filling the washing and rinsing liquor into said tub (5),
    - regulation and control means for the level of the liquor inside said tub (5),
    - heating elements for heating up said liquor,
    - regulation and control means for the temperature of said liquor,

- pump means (10), the suction side of which is joined via water-carrying connecting means (12) to the lowest point of the tub (5),
  - programming means (13) for setting and controlling the sequence
- 5
- as electrically interconnected functional component parts,
- characterized in that the sensors (21, 22) of said regulation and control means for the washing and rinsing liquor are enclosed in a single water-tight casing (20) that is arranged below the minimum level (L) that can be reached by the liquor in the tub (5) during the operating cycles of the machine.
- 10
2. Washing machine according to claim 1, characterized in that said single water-tight casing (20) enclosing the sensors (21, 22) is arranged on an inner surface of the tub (5).
- 20
3. Washing machine according to claim 1 or 2, in which, for washing the clothes, said tub (5) including a rotating drum (8) is part of a washing assembly (4) that is suspended by means of spring means (2) and possibly also vibration-damping means (3) inside the outer casing (1), characterized in that in said single water-tight casing (20) there is also enclosed at least a sensor (25), eg. of the accelerometric type, adapted to detect the oscillations of said washing assembly (4) and preferably associated to means adapted to modify and adjust the dynamic trim of the same washing assembly (4) so as to eliminate possible dynamic imbalance states thereof during the operating cycles of the machine.
- 25
- 30
- 35
4. Washing machine according to any of the preceding claims, characterized in that all said sensors (21, 22, 25) are integrated into a single solid-state component part.
- 40
5. Washing machine according to any of the preceding claims, characterized in that the means (30) for interconnecting the functional component parts of the machine with said sensors (21, 22, 25) are capable of being activated selectively by said programming and sequence control means (13) in accordance with each individual phase of the operating cycles being carried on.
- 45
- 50
6. Washing machine according to any of the preceding claims, characterized in that the sensors (21) relating to said regulation and control means for the temperature of the liquor are of the thermistor-based type and are further adapted to perform as compensating means to thermally compensate the other sensors (22, 25) enclosed in said casing (20).
- 55
7. Washing machine according to any of the preceding claims, characterized in that at least one of said sensors, in particular the one (22) relating to the regulation and control means for the level of the liquor, is associated to connection means (24) for connection to said water-carrying connection means (12) that depart from the lowest point of the tub (5).
8. Automatic vending apparatus according to any of the preceding claims 1 to 6, characterized in that said single water-tight casing (20) enclosing the sensors (21, 22, 25) is arranged on said water-carrying connection means (12) between the suction side of said pump means (10) and the lowest point of the tub (5).

FIG. 1

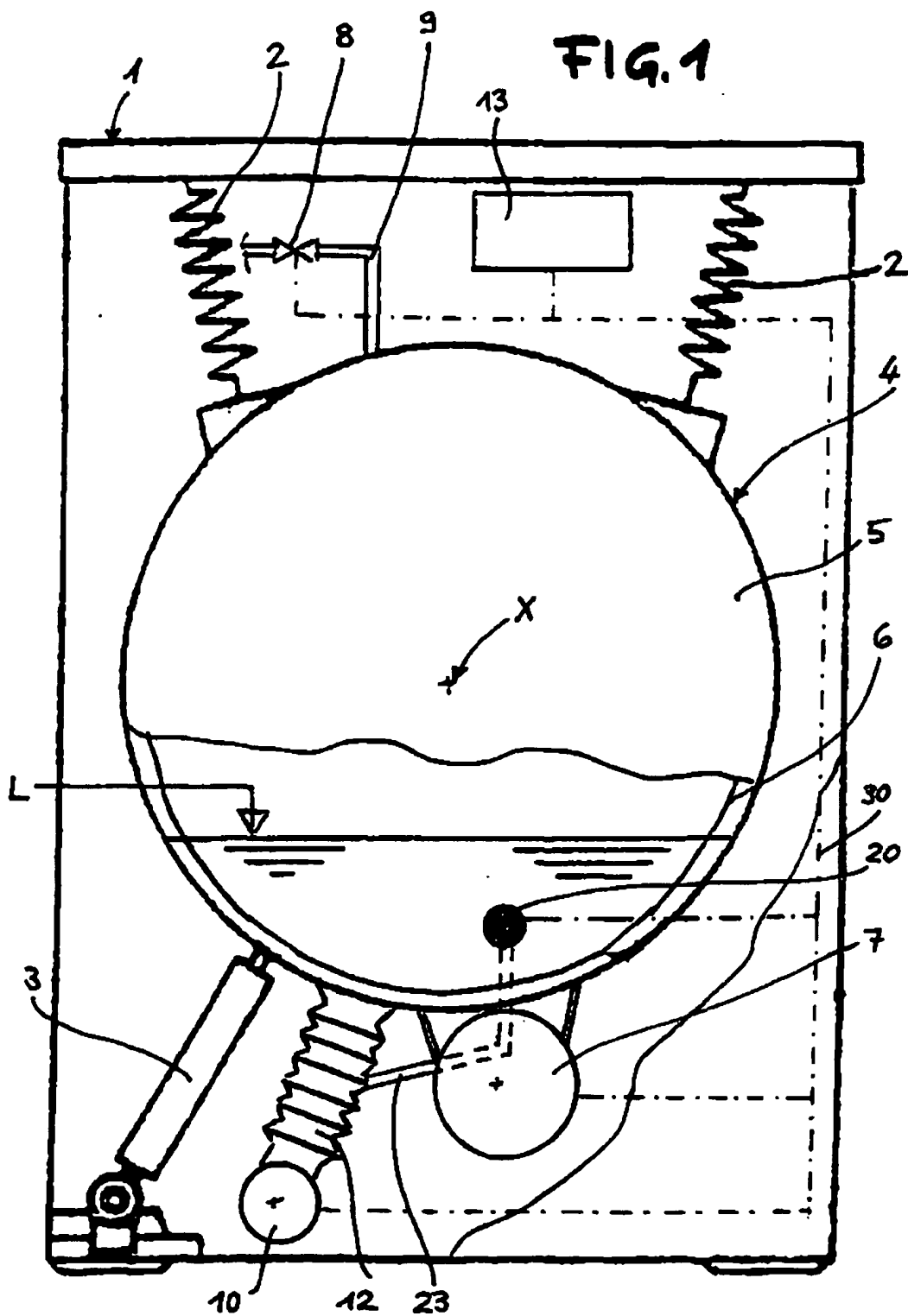
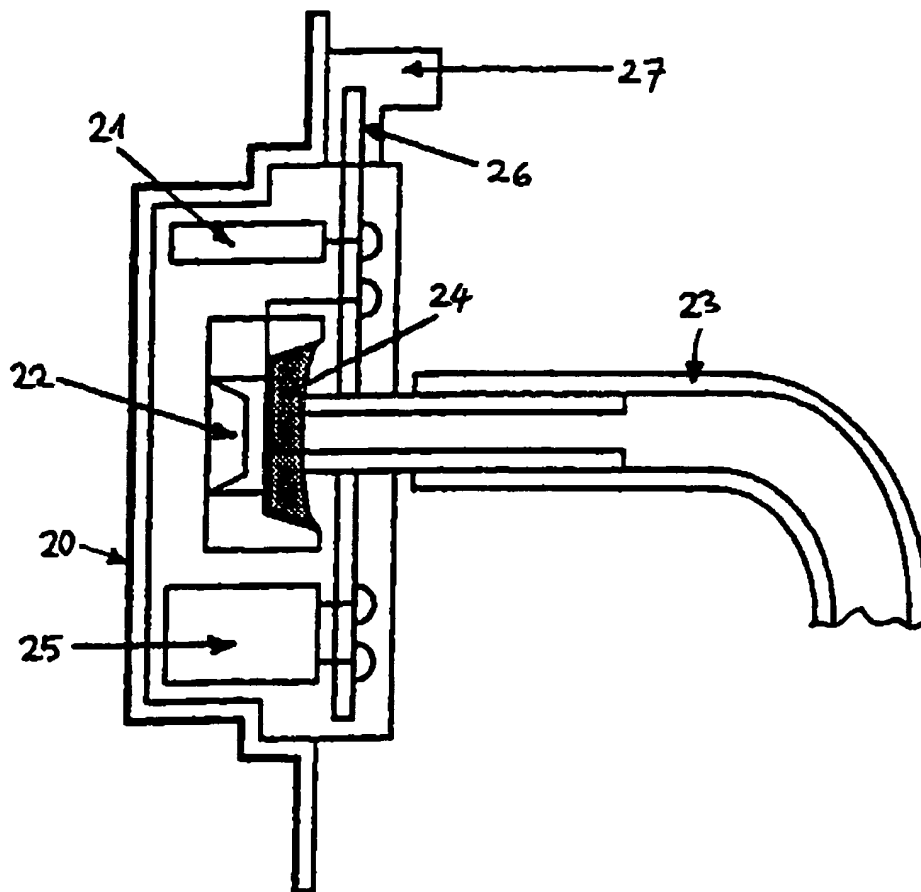


FIG. 2



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